MR. BENTHAM'S ANNIVERSARY ADDRESS TO THE LINNEAN SOCIETY[*]

AS a general summary of the current zoological literature the "Zoological Record" maintains its high value. The volume for 1870 has lately appeared under the new editorship of Mr. Newton, and the arrangements now made for its further prosecution are very hopeful; yet I must again urge upon all our Fellows, who, as amateur zoologists or patrons of the science, have joined our ranks, to give their further support to the "Zoological Record" Association in order to secure the continuance of this annual summary for the sake of the working members, to whom it is so essential. I would also call attention to the sketch of the ornithological works recently published or in progress contained in the last number of the *Ibis*, an example which it were to be wished were regularly followed in all periodicals specially devoted to any branch of our sciences. The Reports on the contributions to the various branches of zoology inserted in Wiegmann's "Archiv" under the editorship of, and some of them compiled by, Troschel, replace in some measure the "Zoological Record" for the German public, and are kept up nearly to the same period, some of the reports for 1870 having already appeared; they are also much to be commended, although they may not have quite the method and completeness of the "Zoological Record." I have further to congratulate science in general on the near completion of the Royal Society's great Catalogue of Scientific Papers, the sixth and last volume of which is far advanced, and likely to be in our hands by the commencement of the next session of the Society.

In Botany, Pritzel's excellent and much-improved second edition of his "Thesaurus" is rapidly going through the press, and brings the repertory of separate botanical works down to the year 1871. Current botanical publications are also generally noticed in various botanical publications, especially the "Giornale Botanico Italiano," edited by Prof. Caruel; the "Flora" of Ratisbon; the "Botanische Zeitung," continued since the death of v. Mohl by A. de Bary; the "Bulletin de la Société Botanique de France," which comprises perhaps the fullest bibliographical review; and the *Journal of Botany*, which promises well under the new and active editorship of Dr. Trimen. But, with the exception of lichenography, the bibliography of which is brought down to the year 1870 in Kreppelhuber's detailed "History and Literature of Lichenology," we have no comprehensive references to Memoirs and Papers published since 1863, the term of the Royal Society's Catalogue, and we feel much the want of an annual summary corresponding to the "Zoological Record."

A work has recently appeared which has naturally attracted much of my attention as being intimately connected with a branch of the science which I have on several occasions taken as the subject of my annual Addresses, and as being the result of long and careful study of the great and varied mass of data collected by its laborious and distinguished author. I speak of Grisebach's "Vegetation of the Earth according to its climatological distribution." The general scope and plan of the work has been recently noticed in an article in NATURE,[†] and I shall on the present occasion confine myself to a few observations on his views with reference to some of those regions or districts to which I had intended to call your attention in my last year's Address.

One of the most interesting of these regions is the Japanese, or the greater part of Grisebach's Chino-Japanese regions, that is, the Japanese islands and opposite coasts of the Asiatic continent. The peculiarities of its flora have been accounted for, upon considerations depending chiefly on origin, in a well-known paper by Asa Gray (Mem. Amer. Acad. new ser. vol. vi. p. 424), whose views are fully coincided in by Maximowicz and others, but strongly objected to formerly by Miquel and now by Grisebach, who relies upon climatological and other physical considerations. It appears to me that this is a strong instance of the combined effects of the two agents as explained in my above-mentioned Address of 1869 (p. 15; Proc. Linn. Soc. 1868-69, p. lxxvii.) The main features of this flora are the mutual intergrafting of northern and tropical types, and the number of highly differentiated endemic or widely dissevered monotypic or almost monotypic races; the former due to physical, the latter to derivative causes.

With regard to the endemic or widely dissevered highly differentiated races (monotypic genera, sections, or very distinct species), Grisebach's views differ widely from those of Asa Gray and other modern naturalists who adopt more or less the theory of evolution. Grisebach, as already observed, entirely ignores community of origin of closely allied or representative species, and is but little disposed to take into consideration ancient dispersion under geological conditions different from the present ones. Each species he believes has arisen—he had formerly said been created, an expression he now abandons in order not to be supposed to prejudge a question which admits of no positive solution—each species has arisen in a particular spot (from what materials he thinks it vain to inquire), under the influence of physical and other external conditions, and has spread more or less in every direction from this birthplace or centre as far as those external conditions have prevailed, and in so far as their progress has been unopposed by insurmountable physical or climatological barriers. In conformity with these views he explains closely allied and representative species in a passage which I give at length for fear of misrepresenting him by an abstract. "The birthplace (*Entstehungsort*) of a plant species," he says, vol. i. p. 515, "may be taken as the most perfect expression of the concordance between the physical life-conditions of the place and the organisation of the plant; for this suitability to given influences of inorganic nature gives the highest measure of the capability of preservation which life strives to attain. Upon these propositions is founded the conclusion, that the nearer the centres of different plants are placed geographically, and the less different are therefore their climatological conditions, the more similar must be their organisation, or, what amounts to the same thing, the more species will have arisen in the same genus. This phenomenon is exhibited in all places where we can compare endemic species whose dispersion is limited, but in islands which have a peculiar vegetation it is less pronounced than in continents. From any one point climate is gradually altered, like the radii of a circle which gradually diverge more and more from each other from the centre to the circumference. In a continent the whole area of the circle may be supposed to be suited to the production of changes in organisation; in an archipelago it is interrupted by the sea, and here, therefore, few similar species have arisen. Another consideration to be taken into account is that genera when compared with each other are unequally susceptible of change (*veränderungsfähig*); their species, therefore, to keep to the same metaphor, will be found arranged at greater or less distances from each other in the radii of the circle. If the area of the continuous land is small, monotypes will have more readily arisen—genera which, on the one hand, are very little or not at all susceptible of change, and on the other hand, can no longer subsist with a certain degree of climatological change. If in a more remote geographical distance the more important climatological conditions which these genera require are repeated, we may, perhaps, find in another part of the globe a second species; and this generally explains the orign of the species which have been termed representative (*vikariirende Arten*). A precisely similar climate, however (exactly the same complication of the very varied phenomenon towards which organisms bear themselves receptively), is never repeated in two distant points of the earth's surface; and this may be taken as the foundation of the absolute unity of centres of vegetation, that is to say, of the proposition that every species in its wanderings has issued from a single birthplace, which does not exclude the possibility of solitary exceptions which might be imagined in plants of less receptivity."

In all this it appears to me that if the writer refuses to admit of a descent from a common parent, we have a right to ask of him what is the previous organisation upon which he imagines climate to have worked to produce allied species in one region and representative species in distant regions? what are the previous genera which have changed? for upon that seems to hinge the whole of his argument in refutation of Asa Gray's hypothesis explanatory of the original connection between the East Asiatic and East American floras. That every species had arisen in one spot, whether by differentiation or by creation, appears now to be tacitly admitted by all. Asa Gray, in accordance with Darwinian theories, supposes widely spread species to have been, under the different conditions of distant lands, gradually modified in different directions, so as to have produced distinct varieties or representative species; Grisebach supposes these different conditions to have independently produced distinct but similar species, by acting on organisms which had not been one and the same species; but what else they may have been he seems to think beyond the reach of plausible conjecture.

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[*] Delivered Friday, May 24, and abridged.

[†] No. 128, April 11, 1872.

Leaving, however, these questions of origin aside, he strongly objects to the classing representative with identical species in considering geographical distribution; for the former appear in such absolutely dissevered distant regions that an interchange of species, even in early geological periods, seems impossible, as, for instance, in the case of several Ericas of the Cape and of Europe. It is on the contrary, he believes, almost always possible to deduce the actual progress of identical species from the form or physical accidents of their homes and from the means of dispersion at their command (p. 519). He therefore, in combating Asa Gray's conclusion, commences by eliminating from his calculations, after the example of Miquel ("Over de Verwantschap der Flora van Japan met Azië en Noord America, Versl. K. Akad." Amsterdam, ser. 2, ii.), all representative species, thus reducing Asa Gray's list of concordant races in Japan and Eastern North America from 226 to 81, from these Grisebach subtracts 41, which are also inhabitants of Western North America, and can still, he thinks, daily transmit their seeds across the Pacific Ocean; 17 more are, in his opinion, supported by that of other botanists, either certainly not identical or doubtful, and to be added to the already eliminated representative species. Of the remaining 23, he finds 21 which can bear a high northern climate and may yet be found in the Oregon or other imperfectly explored territories of North-West America; and the whole long list is thus reduced to two species only, whose problematical disseverance in Japan and Eastern North America remains unexplained—the one, *Elodea petiolata*, being a marsh plant, which as such possesses great migratory powers, the other, *Carex rostrata*, from the White Mountains, awaits further researches on its geographical distribution. Even admitting the possibility of the greater early dispersion of these species in former geological periods propounded by Asa Gray, Grisebach thinks that any such great antiquity of the Japanese flora is not established on so firm a ground as to supersede any attempts at finding other explanations limited to the results of forces still in activity in present times, and that accordingly the distribution of the species in question may be satisfactorily accounted for by the means of dispersion still available, if the data are viewed in the light he has placed them. I should doubt, however, whether his mode of cutting up a long array of ascertained facts further increased by subsequent researches, in order to make them agree with preconceived theories, will carry any stronger conviction into Asa Gray's mind than in my own, more especially as the presumed great antiquity of the Japanese flora is not deduced from these facts alone, but is derived also from other evidences, amongst which the peculiar character of the endemic monotypes bears a prominent part.

With regard to Grisebach's idea that representative and similar species are independently produced by similarity of climatological conditions, and that they afford no conclusive evidence of community of origin, for that they are to be found in widely dissevered localities between which it is impossible to conceive any continuity even in ancient geological periods, and with reference to the instance he adduces of the above-mentioned heaths of the Cape and of Western Europe, I would recall to your minds some remarks I made in my Address of 1869 (p. 25; "Proceedings," p. lxxxvii.) on the remarkable coincidence of several genera, and the near similarity of some species that exists between these two widely dissevered regions. I would now add that if it is difficult to imagine any ancient continuity which should readily explain this phenomenon, it seems equally difficult to account for it by any climatological similarity, if we consider how much Cape plants in general, accustomed to a prolonged summer's sun, suffer from its want in the dull damp seasons of Western Europe.

The Eastern Archipelago, the study of whose fauna, as connected with the history of the great changes it has undergone by successive submersions and upheavals, has been rendered so interesting by the well-known labours of Mr. A. R. Wallace, calls imperatively on the attention of botanists in the search of facts derived from its flora in confirmation or refutation of these views. Unfortunately we are in this respect very much in arrear. The botany of New Guinea is almost wholly unknown; and from Celebes we have but very little. Sumatra, Java, the Philippines, Timor, and a part of Borneo, have been more generally explored, and large collections of their plants have been deposited, chiefly in the Leyden Herbarium, but also in considerable numbers in those of Kew and in some others; but even these materials have been but little worked up in a manner to be available for the geographical botanist. The two eminent Dutch botanists who had successively charge of the Leyden collections contributed much in various ways to the progress of the science and especially to our knowledge of the flora of the principal Dutch islands, but without leaving any satisfactory general view of all that was known on that of the whole archipelago. Blume's "Bijdragen tot de Flora van Nederlandsch Indië," drawn and published at Batavia when he was still very young, was a wonderful work considering the means at his disposal; and after his return to Europe he commenced elucidating with equal ability and in greater detail several orders connected with that flora ("Flora Javæ," "Rumphia," "Museum Lugduno-Batavense"); but as general works all these remained incomplete. Miquel drew up a "Flora Indiæ Bataviæ," purposing to be complete as far as his materials allowed; but it was far too hastily compiled, without the necessary critical examination of genera and species. Since his lamented death I have seen no signs of any Dutch successor likely to take up the study of the botany of the archipelago in any scientific point of view. In the meantime the rich stores collected by P. Beccari in Sarawak are, I am informed, in the course of distribution; and that enterprising Italian naturalist has returned to the East with a view to the exploration of New Guinea and some others of the less known islands.

Grisebach, in his Indian Monsoon region, unites the archipelago with the East Indian peninsulas and continent to the foot of the Himalayas, the Island of Ceylon to the west, and the Society and the Marquesas and other coral islands to the east, embracing, as it were, the whole of Tropical Asia or Sclater's Indian, with a portion of his Australian Palæotropical regions; and certainly a cursory survey of the vegetation of this vast expanse of territory would appear to justify Grisebach's idea of its unity of character. It has also tolerably definite limits determined on the north-west by the drier rocky East Mediterranean or Persian region, on the north by the great Himalayan chain, and on the east and south by a wide extent of ocean; the exceptions being chiefly the above-mentioned innoculation, as it were, into the Japanese flora to the north-east, and more or less of an intrusion across the ocean to the westward into Tropical Africa, and over a narrower interval of sea to the south-east into north-east Australia. The principal cause of this uniformity of character, so far as it goes, is well deduced by Grisebach from climatological and physical conditions, his observations on the chief portion of the region, or East India proper, from Ceylon and the Peninsula to Malacca, being mainly derived from Hooker and Thomson's most instructive introduction to their "Flora Indica," which, from a variety of causes, was unfortunately put a stop to after the issue of the first volume. It is now being replaced by the "Flora of British India," under Dr. Hooker's editorship, of which the first part, just published in a more concise form, gives a confident hope that it may be steadily and rapidly brought to a conclusion. We shall then have ample means of instituting a comparison of the Indian vegetation with that of Boissier's "Flora Orientalis" to the north-west, of Ledebour's "Flora Rossica" to the north, of Miquel's almost as complete, though less methodical enumerations of Japanese plants to the north-east, of the "Flora Australiensis" to the south, and of Oliver's "Tropical African Flora" to the west.

The "Flora Indica" does not, however, extend to the eastern portion of Grisebach's Monsoon region, about which our information is so deficient; but where, as he observes, "the distribution of organisms involves one of the most remarkable problems in the darker regions of vegetation-centres." He further remarks that the flora of this eastern region, with the exception of the Timor group, is everywhere Indian, and regulated by climatological conditions, the vegetation of New Guinea being, as he rather hastily supposes, "thoroughly similar to that of Borneo," a result quite at variance with the distribution of animals as expounded by Wallace. As a possible explanation of this discrepancy, he proposes an hypothesis which, for fear of misrepresentation, I shall give at length:—"Thus the limits of particular forms of plants and of animals in the Indian Archipelago do not concur. Vegetation corresponds to climatological, the fauna to local (*räumliche*) analogies. This opens a wide field for speculation on the history of the globe. By a mere sinking of the land to an unimportant extent, Darwinism readily explains the origin of the fauna of these islands, but not the Indian character of the flora of New Guinea, which presupposes much greater upheavals than the origin of fauna, calculated to give rise to equatorial rainy seasons. This hypothesis would derive the endemic marsupials of New Guinea from the Australian ones after the establishment of the Torres Straits, but it gives no explanation of the way in which the peculiar palms of New Guinea could have arisen from allied Indian genera. With more plausibility, although with little more foundation on ascertained facts, may be put forward another conjecture derived from the respective relations of plants and animals to the outer world. From their organisation the former are much more dependent on climate, the latter on the vegetation which serves them for food. If an extent of sea is converted into land, its climate (independently of its geographical position) will depend on the form of its coasts and on the relief of its surface. If, now, creative forces are pronounced, the forms of vegetation will be suited to the climate. These forms correspond to the climate of the present day, as everywhere else, so also from the Malayan continent to the South-Sea Islands. If we assume that in an earlier geological period the eastern portion of the Archipelago did not yet possess its mountains, and was connected with Australia, so might the Australian climate have then extended to the Archipelago; but with the change in the climate the vegetation of the time must have disappeared. A new flora arose; but in the fauna, which was less dependent on climate, the earlier types may have longer persisted. Perhaps the present period may be regarded as one in which the Australian forms of animals are in an expiring state, because the jungle-forests do not sufficiently correspond to their demands for food. It would appear as if creative activity only wakes up at specific points of time on specific points of the earth's surface, and that during the long pauses Nature's struggles are directed only to the retaining that which exists. Vegetation, as well as the animals which it feeds, must ever be considered in relation to the geological developments. During the time which has elapsed since the mountains and the moist climate of New Guinea have been established no new creation of Mammalia has taken place. Only very few Marsupials, and scarcely any other Mammalia, have been found on this great island. But in other classes of animals forms have arisen corresponding to the present vegetation, such as the Birds of Paradise, which are unknown in Australia, but which in New Guinea hover over the forest tree-tops, whilst they can take shelter from the mid-day sun under the dense foliage. . . . The present type of organisation was already cast in New Holland in the tertiary period, whilst the endemic plants and animals of New Guinea appear to be of much later origin" (vol. ii. pp. 69, 70).

Without admitting to its fullest extent the main fact relied upon, that there is no marked line separating the vegetation of the western and the eastern portions of the Archipelago corresponding to that laid down by Wallace for animals, a premature conclusion in the present state of our knowledge,[*] and still less entering into speculations as to the intermittent action of creative forces which I do not quite comprehend, we must agree with Grisebach that, so far as shown by the scanty data at our command, the uniformity is much greater in the botany than in the zoology of the whole Archipelago. We may also admit with him that this comparative uniformity may be, in great measure, due to the uniformity of climate acting more upon plants than upon animals. But there are other circumstances which may probably have favoured the continued action of natural selection through countless ages in procuring this result. Dr. Hooker has very plausibly suggested a greater geological antiquity in the plant races than in those of animals, especially the higher animals, under which the former, or the ancestors from which they are descended, had become established over a wide extent of continuous land before its successive disruption, upheavals, and depressions producing the present isolation. We must next take into account that this continuity of land need not be so great in the case of plants as of animals. The dispersion of the former is passive, and takes place chiefly in a dormant state, in which minuteness and enormous multiplication afford them opportunities for crossing seas and other barriers denied to the higher animals. Plant races of accommodating (*accomodationsfähiger*) constitutions, as they successively arose and attained the full vigour of specific life, will have early spread over any continuous or but little broken area, enjoying comparatively similar physical and climatological conditions, the western and eastern forms intermingling, so as that the one should only gradually be replaced by the other, thus in early ages repeating under the tropics the phenomenon now observed in the northern temperate Europeo-Asiatic region. These vigorous or accommodating races, whether new differentiations or foreign invasions, will at the same time have gradually expelled and replaced races which in tertiary or other previous periods had occupied the land under different conditions, and which now could only maintain themselves in the struggle for life in localities affording them, in their reduced or weakened state, special protection against the effects of the altered climate and the attacks of their vigorous competitors. Such localities, suited to ancient or expiring races of few individuals, with varied but always special requirements, and generally slow of propagation, may be exemplified in the Mediterranean, the Japanese, and other regions abounding, as Grisebach terms it, in centres of vegetation; they may be faintly traced in the Nilgherries and in Ceylon; but are in general very few in Grisebach's Monsoon region, and those few are as yet but little known or wholly unvisited. Kini-Balu, in Borneo, has, however, as we learn from Dr. Hooker, supplied a place of refuge for a certain number of Australian types, and it may be conjectured that many more may have maintained themselves in those lofty mountains of New Guinea which have as yet been only seen from a distance. Continuity of vegetation probably existed in tertiary times between Australia and a vast extent of land including more or less of both of Wallace's divisions of the Archipelago. How far subsequent changes which have influenced the present distribution of animals may have affected that of the forest vegetation, can only be judged of when the floras of Borneo, Celebes, and New Guinea shall have been as well investigated and compared as have been those of Sumatra and Java.

(*To be continued*)

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[*] Dr. Hooker has, for instance, remarked that no Dipterocarpeæ have been found to the east of Borneo.

SCIENTIFIC SERIALS

In the *Journal of Botany* for May the editor, Dr. H. Trimen, describes a species of *Luzula* new to the Flora of Europe, *L. purpurea* Link, of which a drawing is given.—Mr. J. G. Baker concludes his revision of the Cape species of *Anthericum.*—Mr. Archer Briggs notices some peculiarities of the botany of the neighbourhood of Plymouth, principally with reference to species common elsewhere which are absent from the south-western extremity of our island.—Mr. O'Meara continues his researches on Diatomaceæ.

The number for the present month opens with a note on Dimorphism in *Eranthemum* by Mr. John Scott.—The other original articles are Notes on British Gentianaceæ by Mr. James Britten, and Supplementary Notes on the *Erysiphei* of the United States by Messrs. Cooke and Peck. Several valuable reprints, as well as many interesting short notes and queries, also appear in both these numbers.

The *Canadian Naturalist*, vol. vi. No. 3, is almost wholly devoted to Geology, commencing with a continuation of Principal Dawson's series of papers on the Post-pliocene Geology of Canada, the portion of the subject specially treated of in this number being the local details.—Prof. Sterry Hunt's "History of the names Cambrian and Silurian in Geology" has already been reprinted in our columns.—Mr. E. Billings contributes some "Remarks on the Taconic Controversy," in which he defends the views of Dr. Emmons with regard to the position of these rocks, and a note on the genus *Obolellina.*—The only new geological article is Prof. Smallwood's " Meteorological Results for Montreal for the year 1871.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 30.—" On the Structure and Function of the Rods of the Cochlea in Man and other Mammals." By Urban Pritchard, M.D.

The aim of this paper is to describe the true construction and use of the cochlea, so far as its task of distinguishing the various sounds is concerned. This cochlea, it must be borne in mind, consists of a spiral canal, in form and shape very similar to the inside of a snail-shell. From the axis of this spiral there proceeds horizontally a plate of bone, the *lamina spiralis*, almost dividing this canal into two. From this plate again there extend two membranes, the membrane of Russner, and the Lamina